United States Department of the Interior

GEOLOGICAL SURVEY
Branch of Atlantic Marine Geology
Woods Hole, MA 02543

83005

UNITED STATES GOVERNMENT
MEMORANDUM

DATE: November 4, 1983

FROM: Anne Trehu

SUBJECT: Cruise report for GY-83-12

TO: Bill Dillon

1) Ship name: R/V GYRE

2) Cruise number: 12

3) Parent project: Continental margin deep crustal and seismicity studies

4) Funding agency: USGS (SIR FY83-84)

5) Funding amount: $197,000

6) Project numbers: 9470-01831 (57%), 9470-01796 (25%)
9470-11834 (13%), 9470-03629 (5%)

7) Project start and end dates: FY83-84

8) Area of operations: Carolina Trough, offshore Florida, southern Blake Plateau

9) Start: Sept. 22, 1983, Woods Hole, MA
End: Oct. 6, 1983, Miami, FL

10) Chief scientist: Anne Trehu

11) Ship captain: Richard Ilse

Scientific party: D. Blackwood, J. Connell, R. Davis, J. Dodd, D. Folger, B. Irwin, C. Lane, G. LeMarre, D. Nichols, J. Pulliam, B. Strahle (all U.S.G.S.); G. Jennings (Eliason Data).

12) Purpose of cruise:

The primary purpose of the cruise was to collect air gun-ocean bottom seismometer (OBIP) refraction and multichannel reflection data along lines along which we plan to shoot long range explosive refraction profiles next spring. The objective of this pair of cruises is to determine the structure of the crust beneath the Carolina Trough and in the transition zone from the marginal basin to oceanic crust. During this cruise, we hoped to obtain closely spaced refraction data (300-400m spacing) out to a range of 30-40 km accompanied by multichannel reflection data in order to precisely determine the velocity - depth function in the sediments; with the explosives, we expect to obtain data to a range of over 150 km (2 km shot spacing) to determine the deeper crustal structure down to the Moho. By deploying a near-bottom current meter (VACM) and taking 5 ft. long gravity cores at each OBIP site, we also hoped to collect data on the effect of bottom currents on the coupling of the seismometers to the seafloor in a region where the bottom currents may be quite strong. ~~This~~ These data ~~was~~ were to provide a basis for determining what shot sizes to use and whether to record hydrophone, geophones, or both during the explosive refraction experiment. After shooting the refraction lines, while the VACMs and OBIPs were passively recording the background noise level, we planned to shoot several additional high resolution multichannel reflection profiles over the gas hydrates on the Blake Outer Rise. After retrieving the OPIBs and VACMs, we planned to shoot a single channel seismic reflection profile along the Florida coast 3 miles offshore for Pete Popenoe.

The wind and waves, however, conspired against the above plan. An extensive stationary front of bad weather, which was to develop into tropical storm Dean, was covering the entire region of the planned experiment when we arrived at our first site, and northerly winds of up to 35-40 knots against

the Gulf Stream were resulting in very choppy 15 ft. seas. Deploying the VACMs, OBIPs and multichannel streamer under such conditions was unthinkable. While waiting for the weather to improve, we tried to core and to conduct a 3.5 kH echosounding survey of the instrument deployment sites, but these attempts were aborted because of the sea state.

After 3 days of hoping in vain for an improvement in the weather, we decided to leave the area and head south to shoot the single channel line offshore Florida. The single channel line was shot with the 40 in^3 air gun and recorded on the 200 element streamer. Digital data was collected on the DFS V. The moniter records show pronounced karst topography on a surface approximately 0.5 seconds beneath the present seafloor, and the digital data will permit further processing to bring out these features.

Meanwhile, we obtained alternate coordinates for a refraction experiment from Woods Hole. As a result, we shot refraction lines at two sites straddling the Jacksonville Fracture Zone on the Southern Blake Plateau. This fracture zone separates the Blake Plateau Basin from the Bahama Basin and we expect the depth to basement to change from about 5 1/2 km to about 9 km as we go from the Bahama to the Blake Plateau Basin.

Two OBIPs and one VACM were deployed at site I (southwest of the Jacksonville Fracture Zone), and three gravity cores were attempted. The bottom sediment in this area is very hard carbonate sand and either the core did not penetrate the bottom or the sand was flushed out of the barrel during retrieval. Approximately 1/2 cup of coarse sand composed primarily of foramniferal tests was obtained from the second attempt. Combined with the high bottom reflectivity observed from the 3.5 kH echosounder, this provides the information needed for the seismometer-seafloor coupling study. A refraction line (line 2) along a trend parallel to the fracture zone was then

shot using the 2000 in^3 air gun borrowed from the Bedford Institute of Oceanography. A line 80 km long (40 km on each side of the instrument site for a split profile geometry) was planned. Soon after beginning the line, however, the air gun failed. Because we were shooting into a fixed number of windows in the OBIP, the time lost repairing the air gun resulted in many "lost" windows and only 55 km of refraction data with a maximum range of 40 km was recorded; moreover, we were not able to shoot the gun at full pressurre, resulting in a decrease in source energy of approximately 60% (determined from the observed bubble pulse period and the theoretical energy frequency relationship). The 24 channel, 1200 m streamer was also deployed while the refraction line was being shot, and 4-5 fold multichannel reflection data were collected on the DFS V. The two OBIPs and VACM were then left to passively record the background noise level as we proceeded to site II.

The same type of seafloor was found at site II (northeast of the Jacksonville Fracture Zone); approximately 1/4 cup of carbonate sand was obtained from one of 2 coring attempts. Two OBIPs were deployed, and 50 km of refraction with a maximum range of 37 km were recorded (line 3). The OBIPs were then retrieved.

Returning to site I, we retrieved the 2 OBIPs, redeployed 2 more, and shot an L-shaped line resulting in a line perpendicular to line 2 (line 4) and completing the split profile geometry of line 2 (line 5). We then retrieved the two OBIPs and VACM and headed toward Florida to finish the single channel seismic line.

Out of 6 OBIP and 1 VACM deployments, all instruments were deployed and retrieved without problem. Five of the OBIPs recorded data from three orthogonal geophones for the duration of the deployment; the cartridge recorder in the sixth OBIP failed after approximately 50 events.

Unfortunately, the preamp for the hydrophone was mismatched, and no data were collected from that channel. The VACM recorded data on the current speed and direction, water temperature, and light transmission. Bottom currents ranging from 2 cm/sec to 25 cm/sec were observed. The signal to noise ratio of the seismic data is quite poor, and clear first arrivals are seen only to a range of about 15-20 km. This may be related to the strong bottom currents.

It should be pointed out that this was the first major cruise for the microprocessor based OBIP, and the ease with which a relatively inexperienced team (Jennings, Pulliam and Trehu) was able to prepare the instruments for deployment and redeployment suggests that these instruments should soon be available for a broad range of experiments throughout the USGS.

13) Navigation techniques: INS (lines 2-5); radar (line 1 and 1A).

14) List of scientific equipment employed:

4 OBIPs

1 VACM

1200 m, 24 channel streamer

200 element, single channel streamer

2000 in^3 air gun

40 in^3 air gun with waveshaper

3.5 kH echosounder

gravity corer with 5 ft PCV pipe for core barrel

15) Tabulated information:

a. Days at sea: 14.2 days.

b. Number of kms of continuous data:
400 km single channel, digital seismic reflection.
210 km multichannel reflection and OBIP refraction.
700 km 3.5 kH echosounding.

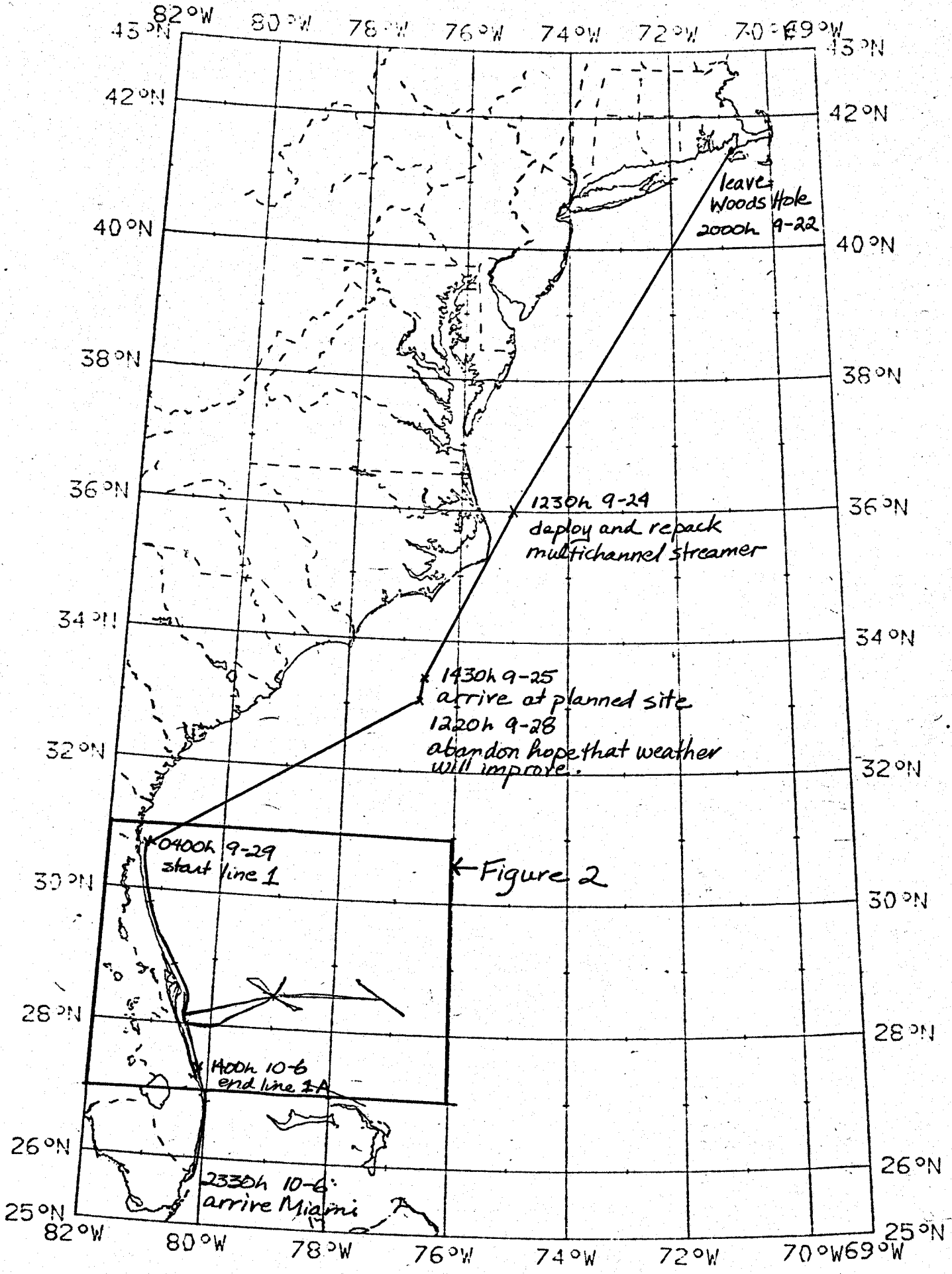
c. Number of stations:
6 OBIP stations
1 VACM station
5 coring stations

d. Number of submersible dives: 0

e. Table of station information:

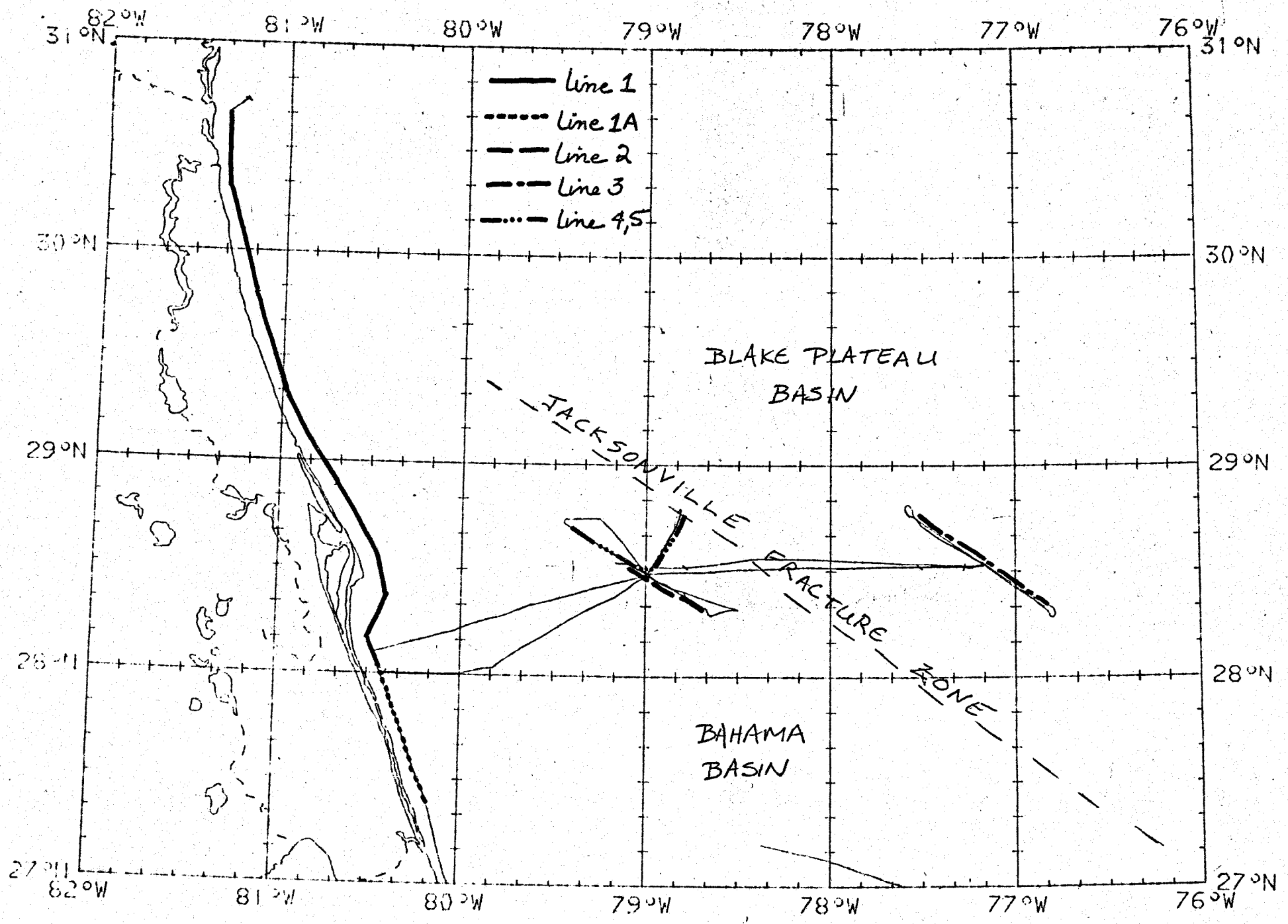
number	date	latitude	longitude	water depth	type	remarks
1	10/01	28°28.78'	78°59.73'	845 m	VACM	----
2	10/01	28°28.15'	78°59.50'	843 m	gravity core	no sample
3	10/01	28°27.80'	78°59.54'	853 m	gravity core	1/2 cup
4	10/01	28°28.70'	78°59.68'	843 m	gravity core	no sample
5	10/01	28°29.03'	78°59.81'	845 m	OBIP	A8
6	10/01	28°28.87'	78°59.75'	845 m	OBIP	A1
7	10/02	28°31.89'	77°10.72'	1040 m	OBIP	A3
8	10/02	28°31.97'	77°10.47	1040 m	OBIP	A2
9	10/04	28°31.86	47°10.56	1040 m	gravity core	no sample
10	10/04	28°31.75	77°10.42	1040 m	gravity core	1/4 cup
11	10/04	28°28.81	78°59.78'	840 m	OBIP	A1
12	10/04	28°28.80'	78°59.79'	838 m	OBIP	A3

cc: Tom Aldrich
Kim Klitgord
Pete Popenoe
Bruce Ambuter
All members of scientific party



Cruise track 64-83-12

Figure 1.



Seismic Lines GY-83-12

Figure 2